NISTTech

Mode-Locked Pulse Laser System & Method

Manufacture inexpensive and highly accurate optical clocks or explore other applications in extreme nonlinear optics

Description

This recent advance in the optical frequency measurement technology connects optical combs and the entire optical spectrum to a reliable time standard. This advance may permit control of optical waveforms which is important in ultrafast science.

This method and apparatus uses wide-bandwidth optical frequency combs with mode-locked lasers to stabilize the carrier phase with respect to the envelope of the emitted pulses. Frequency domain techniques produce a series of regularly spaced frequencies that form a "comb" spanning the optical spectrum. The absolute optical frequency of all the comb lines may be determined by directly referencing the comb spacing and position to the microwave cesium time standard.

Applications

- **Metrology**
  Makes measurement of absolute optical frequencies possible only using a single laser leading to such outcomes as inexpensive and highly accurate optical clocks
- **Extreme nonlinear optics**
  May lead to control of optical waveforms

Advantages

- **Small size**
  Allows for a compact and relatively inexpensive laser system that locks the phase of a mode-locked pulsed laser to the phase of the carrier wave
- **Does not require any external optical input**
- **Platform technology**
  Expected to encourage development of new technologies building on this capability

Abstract

Disclosed is a system and method for stabilizing the carrier-envelope phase of the pulses emitted by a femtosecond mode-locked laser by using the powerful tools of frequency-domain laser stabilization. Control of the pulse-to-pulse carrier-envelope phases was confirmed using temporal cross correlation. This phase stabilization locks the absolute frequencies emitted by the laser, which is used to perform absolute optical frequency measurements that were directly referenced to a stable microwave clock.

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References

- U.S. Patent # 6,850,543 issued 02-01-2005 , expires 03/18/2023
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Status of Availability

patent active and available for licensing

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